

We are using 19 operations in the verilog code

the first 5 digits in instruction are the opcodes that is 16-12

next 3 digits are data register da that is 11-9

next 3 digits are register A that is 8-6

next 3 digits are register B that is 5-3

these values change according to the opcode.

The operations are as follows

1st function of the Instruction Decoder is a no operation

2nd is loading

3rd is storing

4th is moving

5th is jump register

6th is only jump

7th is jump and link

8th is And Immediate

9th is exclusive OR

10th is OR

11th is compliment

12th is logical shift left

13th is logical shift right

14th is ADD

15th is Add immediate

16th is Subtraction

17th is branch if non zero

18th is branch if zero and

19th is set if less than

In Test bench all the instructions are hard coded.
after simulation the following is the observation

for no operation opcode is 00000
all the values are 0

for loading opcode is 00001
RW=1
MD=01
DA=register 1
AA=register 2
rest of them are 0.

for storing opcode is 00010
DA=register 1
AA=register 2
BA=register 3
MW=1
rest of them are 0.

for moving opcode is 00011
RW=1
DA=register 1
AA=register 2
BA=register 3
Function select in ALU is 0001
rest of them are 0.

for JUMP Register opcode is 01010

BS=01

AA=register 2

Function select in ALU is 1000

Mux B=1

CS=1

rest of them are 0.

for JUMP opcode is 01011

MW=1

AA=register 2

BA=register 3

rest of them are 0.

for Jump and link opcode is 01100

RW=1

DA=register 1

AA=register 2

Function select in ALU is 1101

rest of them are 0.

for AND Immediate opcode is 10000

RW=1

DA=register 1

rest of them are 0.

for Exclusive OR opcode is 10001

RW=1

DA=register 1

AA=register 2

BA=register 3

Function select in ALU is 1010

rest of them are 0.

for OR opcode is 10010

RW=1

DA=register 1

AA=register 2

Mux B=1

Function select in ALU is 1001

rest of them are 0.

for Compliment opcode is 10011

RW=1

DA=register 1

AA=register 2

Function select in ALU is 0001

rest of them are 0.

for logical shift left opcode is 10101

RW=1

DA=register 1

AA=register 2

Function select in ALU is 0110

rest of them are 0.

for logical shift right opcode is 10110

RW=1

DA=register 1

AA=register 2

Function select in ALU is 0111

rest of them are 0.

for ADD opcode is 11001

RW=1

DA=register 1

AA=register 2

BA=register 3

Function select in ALU is 0000

rest of them are 0.

for ADD immediate opcode is 11010

RW=1

DA=register 1

AA=register 2

Function select in ALU is 0000

Mux B=1

rest of them are 0.

for SUB opcode is 11011

RW=1

DA=register 1

AA=register 2

BA=register 3

Function select in ALU is 0001

rest of them are 0.

for Branch if non zero opcode is 11100

AA=register 2

Function select in ALU is 1000

BS =11

PS=1

mux B=1

CS=1

rest of them are 0.

for Branch if zero opcode is 11101

AA=register 2

Function select in ALU is 1000

BS =01

mux B=1

CS=1

rest of them are 0

for set if less than opcode is 11111

Rw=1

DA=register 1

AA=register 2

BA=register 3

Function select in ALU is 1001

rest of them are 0